

# **Comprehensive Geostatistical Technology on PC Platform**

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## **Abstract**

Geostatistics has attracted the attention of many earth scientist and engineers who need better modeling tools for natural gas reservoirs. Two years ago Correlations Company responded to this need through the peer reviewed, DOE Small Business Innovative Research program to develop a fractal algorithm for interpolating between measurements and mapping the consequences. During the two years research period Correlations Company has combined geostatistical modeling with high quality graphics to produce Gviz. This software provides accurate 3D reservoir modeling tools and high quality 3D graphics for PC platforms enabling engineers and geologists to better comprehend reservoirs and consequently improve their decisions. Until recently geostatistical modeling was only available to the limited number of earth scientist familiar with UNIX based platforms. Gviz runs on any PC with Windows 95 or Windows NT operating system.

The Gviz pre-processing module reads LAS and ASCII files. The pre-processing module facilitates selection of the stratigraphic units prior to processing by a nearest neighbor, kriging and co-kriging, conditional simulation, or fractal module. A user friendly GUI simplifies the examination of the statistical data and the geostatistical analyses using isotropic and anisotropic variograms. After completing the analyses, the post-processing unit can generate 1D models of well logs, 2D models such as cross-sections, or a 3D model of any petrophysical property. Post-processing includes the display of reservoir slices, multiple cross-sections, rotation along any axis, and identification of geobodies (visually inspect the effect of porosity cutoffs on connected pore volume). The post-processor includes an up-scaling module to transform a fine scale grid into a reservoir simulation grid which can then be exported in an Eclipse format.

Gviz emphasizes a self-explanatory GUI and visually oriented help pages which guides even a novice through the process of generating realistic, two to five million cell, 3D reservoir models. Beta testing of Gviz will finish in April 1997 and a working version of the PC software package, at one fifth of the cost of a comparable UNIX system, will be available to domestic gas and oil producers in mid-1997.

## **Acknowledgments**

Royal Watts was the initial FETC Contracting Officer's Representative during the Phase I and Phase II performance period ( 33 months ending in March 1997). Following Mr. Watts' retirement, Mr. William J. Gwilliam has assisted Correlations Company in completing the contract.

# GViz 1.0

High Performance Geostatistical  
Mapping & Visualization Package

For

Windows 95

&

Windows NT - 4

# GViz Unique Features

- ❑ Includes five fast geostatistical algorithms.
- ❑ High quality graphics and user friendly graphical user interface.
- ❑ Import and Export tools for easy flow of data from GViz to other Software.
- ❑ As many as 2 million cells model.
- ❑ Available on a PC with 500 MHz DEC Alpha processor for large models.

# Correlations Company

Provides Full Reservoir Description Services.

The Company's Expertise is:

- ❑ Geostatistical modeling using GViz.
- ❑ Software development for Windows 95 and Windows NT – 4.
- ❑ Special reservoir description problems:
  - ✓ Modeling fractured reservoirs with limited data.
  - ✓ Modeling old fields with limited data.

# Mapping Methods

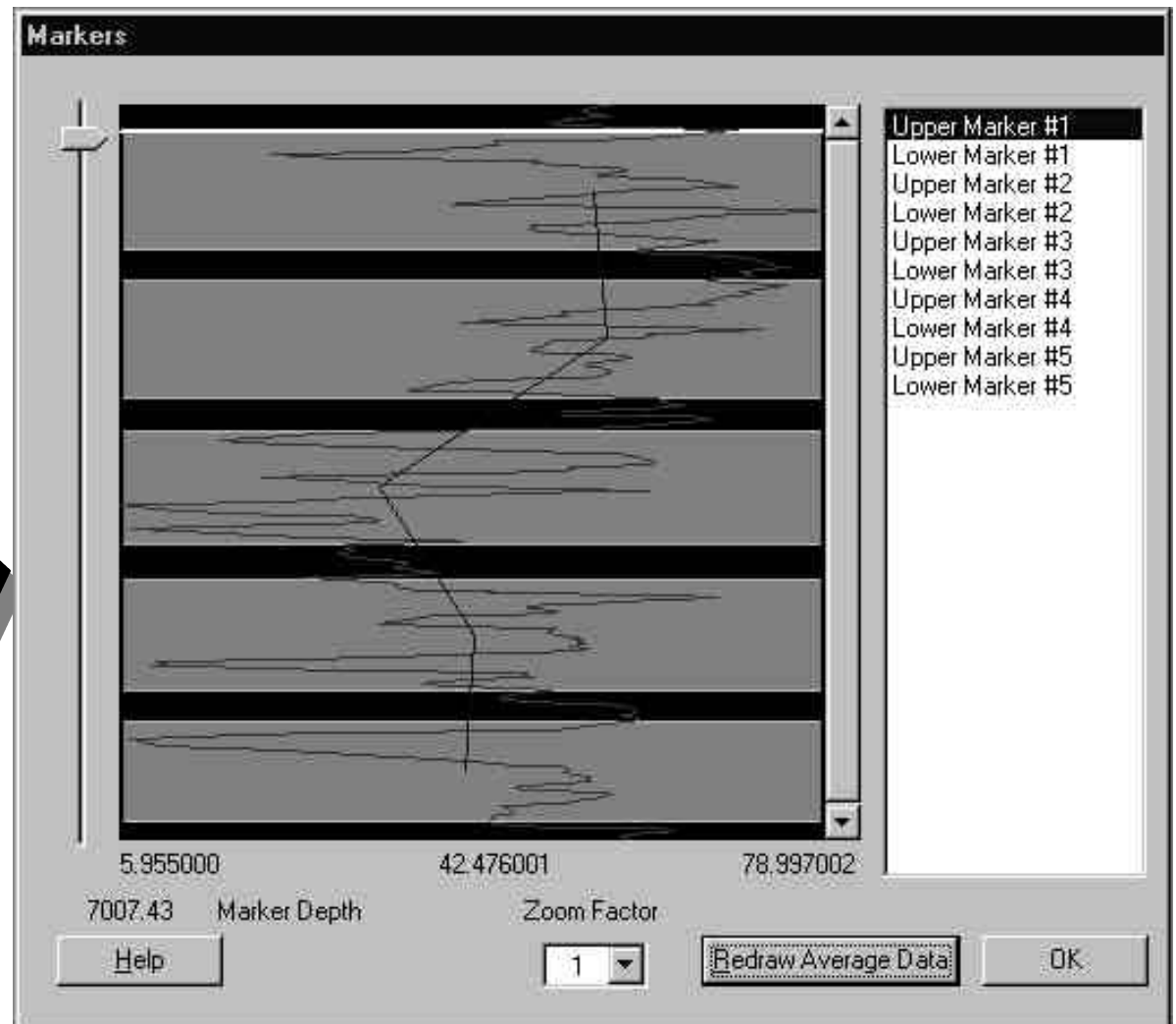
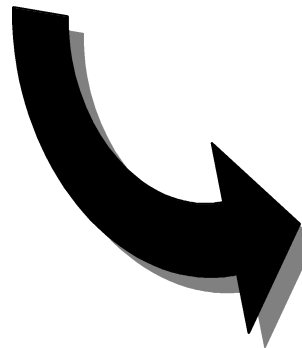
- ☐ Deterministic/ Nearest Neighbor methods
- ☐ Kriging/Co-Kriging
- ☐ Unconditional/Conditional Simulation
- ☐ Fractal Simulation

# Map Post Processing

- ☐ Boolean Maps
- ☐ Additive Combination
- ☐ Multiplicative Combination
- ☐ Map Conditioning
- ☐ Jack-Knife/Map Validation

# Importing

- ☐ LAS Well Log files.
- ☐ Import ASCII files.
- ☐ Selection of stratigraphic markers within GViz.



# Data File

[col] "X(ft)" "Y(ft)" "Z(ft)" "Porosity(%)"

[log] "3-1"

21	81	1915.5	18.024
----	----	--------	--------

21	81	1918	16.796
----	----	------	--------

21	81	1920.5	14.278
----	----	--------	--------

21	81	1923	10.86
----	----	------	-------

21	81	1925.5	9.806
----	----	--------	-------

[log] "8-1"

16	79	1946	8.02
----	----	------	------

16	79	1948.5	10.112
----	----	--------	--------

16	79	1951	9.408
----	----	------	-------

16	79	1953.5	17.79
----	----	--------	-------

16	79	1956	14.41
----	----	------	-------

[log] "2-3"

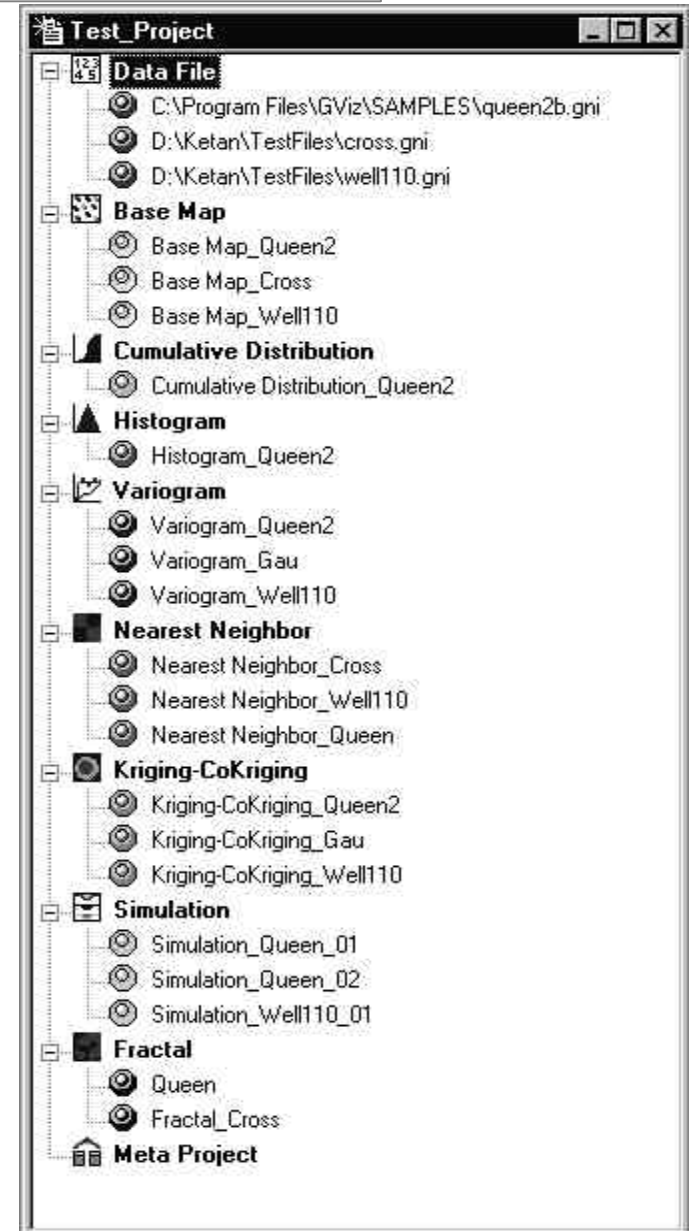
14	82	1942	6.2
----	----	------	-----

14	82	1943.5	11.156
----	----	--------	--------

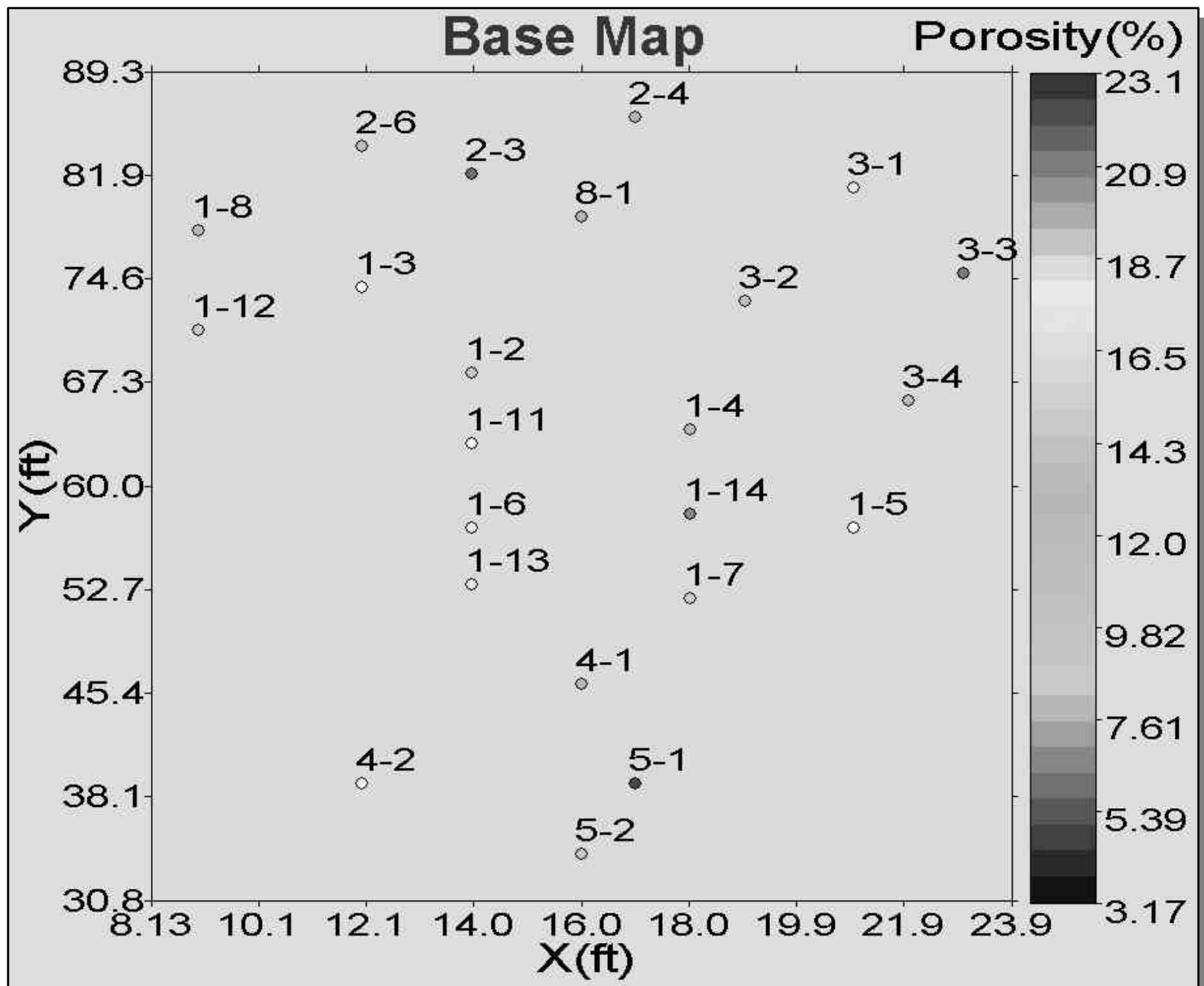
Create your  
Input file in  
  
Word Processor,  
Spreadsheet,  
Or  
any ASCII Editor

# GViz Project Manager

- ✓ Single Integrated Environment
- ✓ Create, Modify and View Maps and Plots
- ✓ Easy to use Graphical User Interface

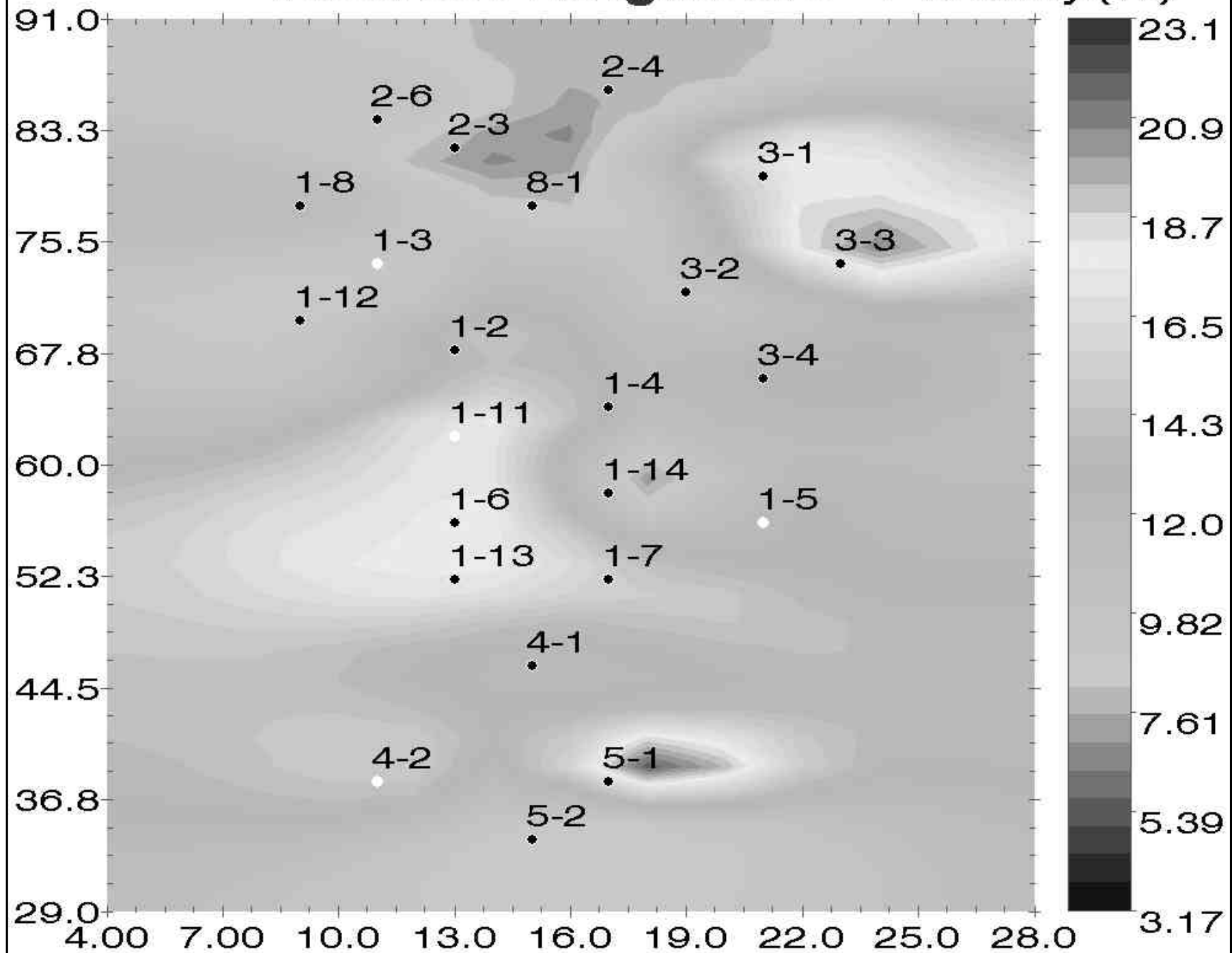


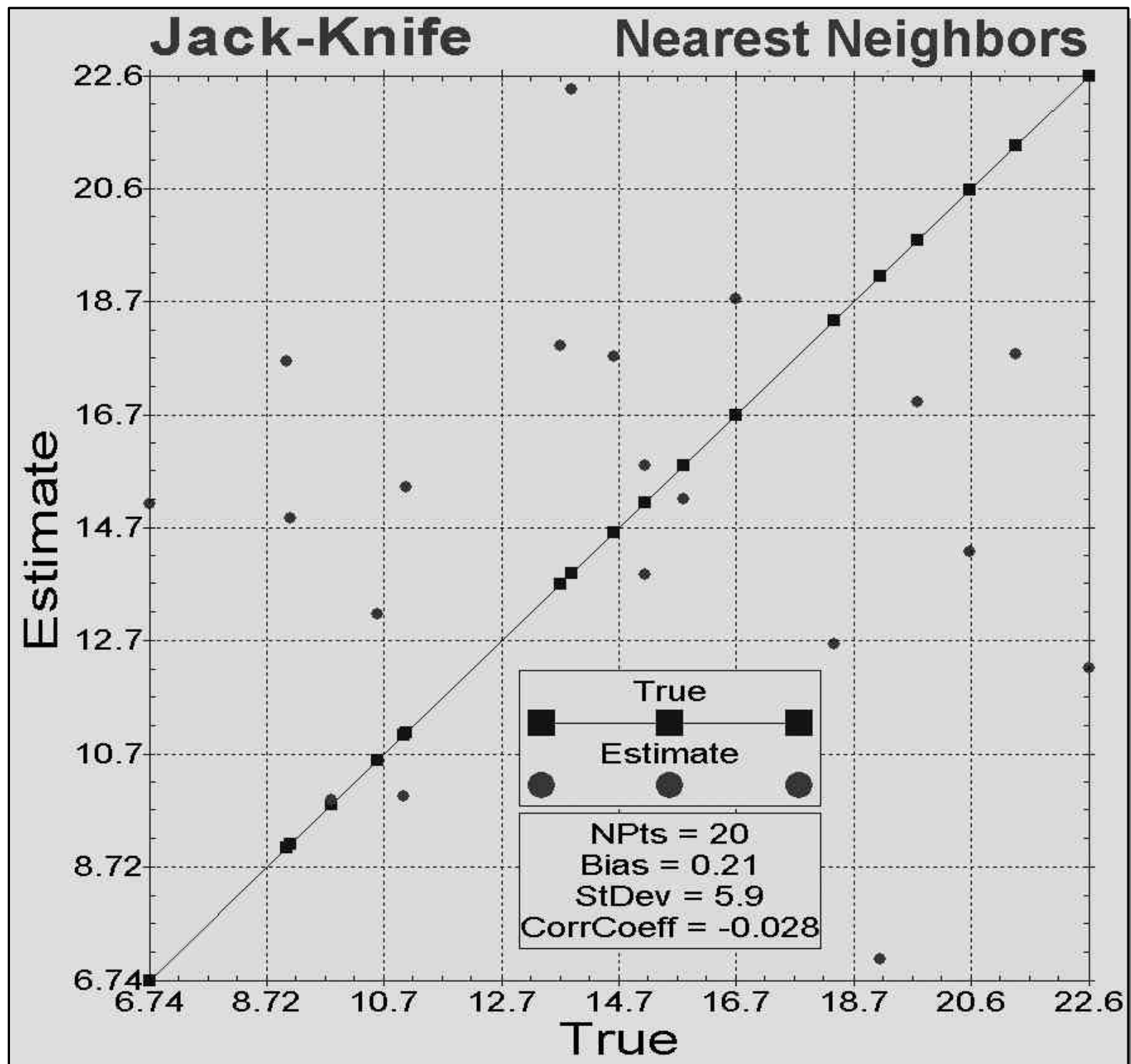




# Nearest Neighbors

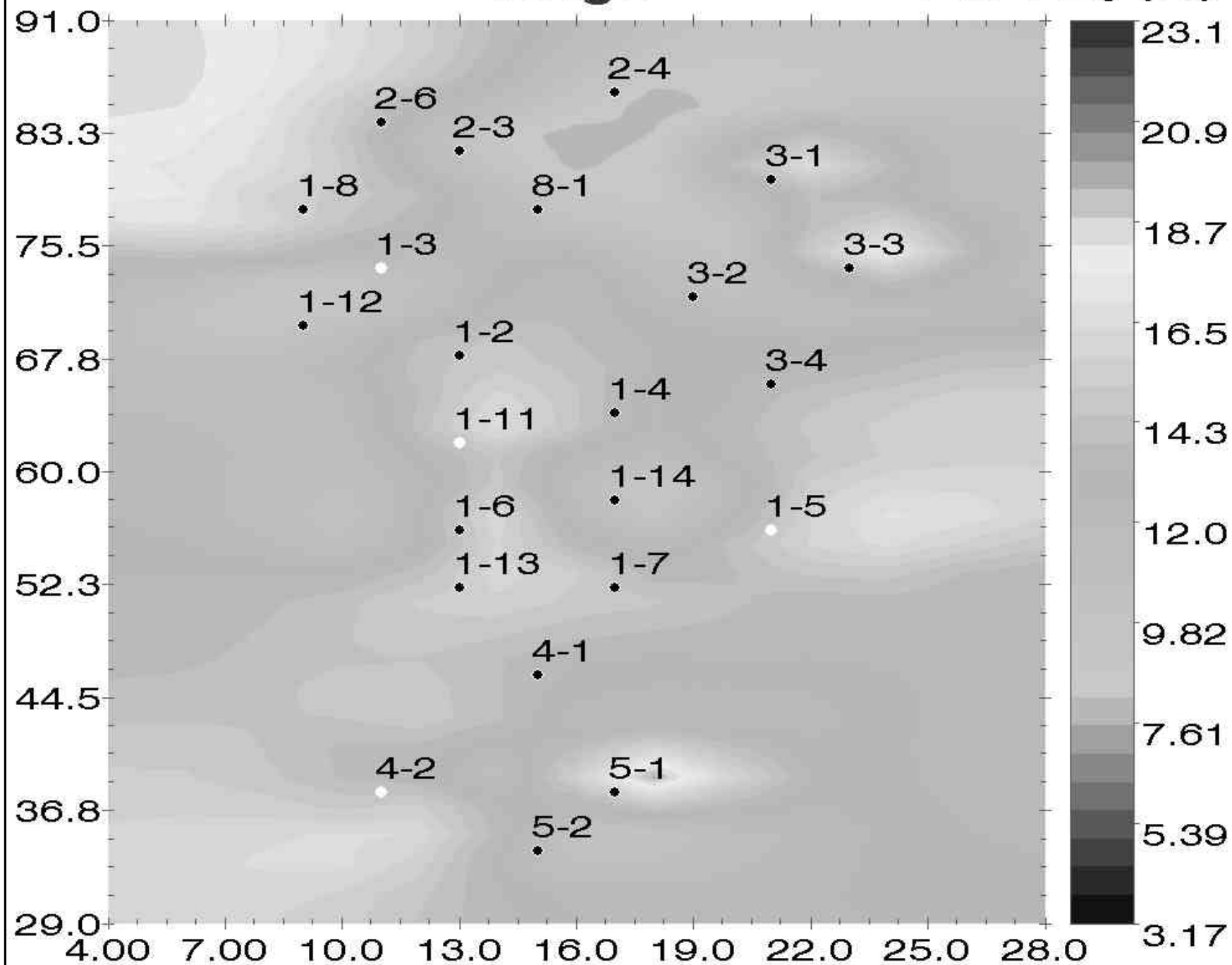
Porosity(%)

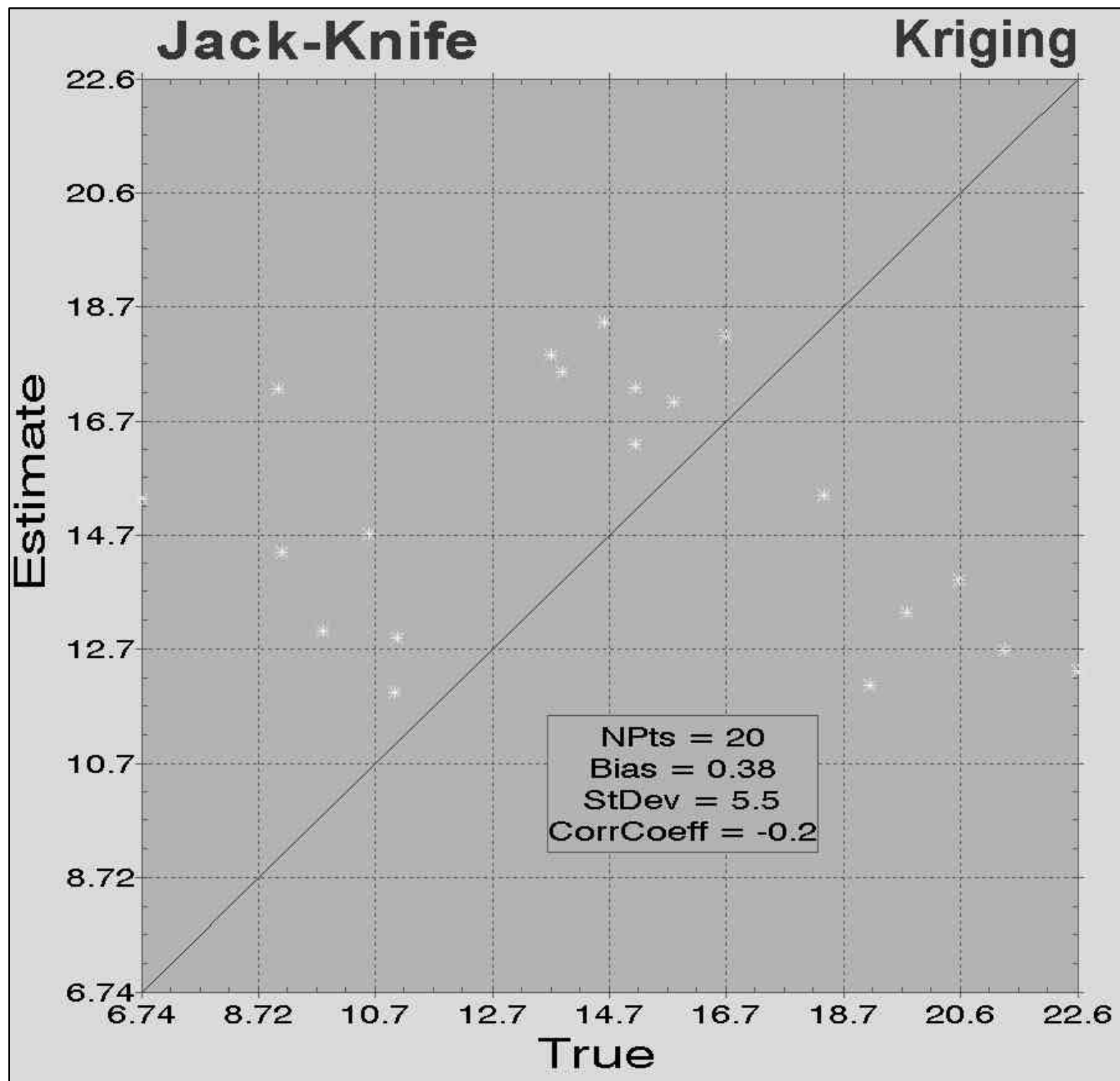


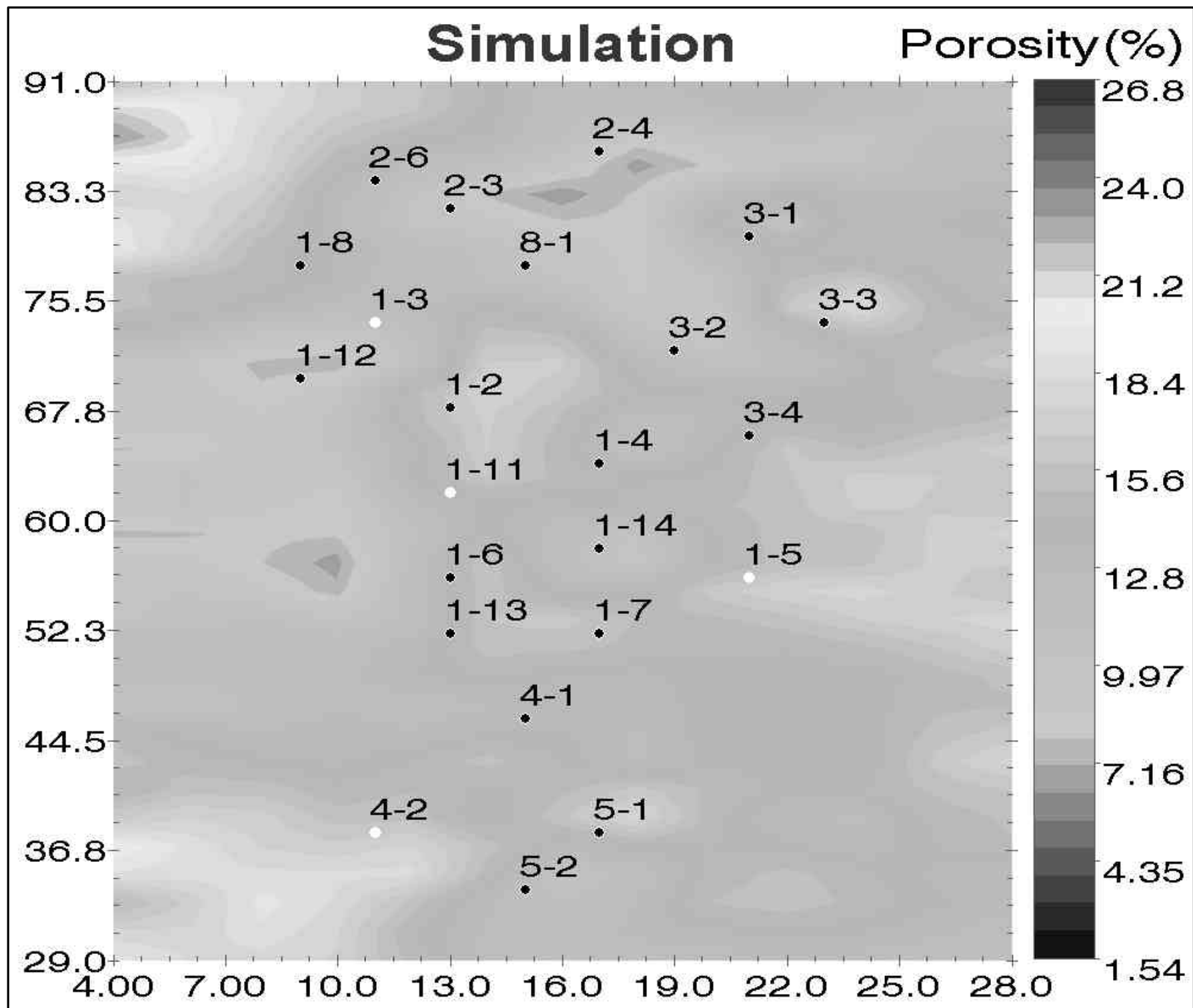


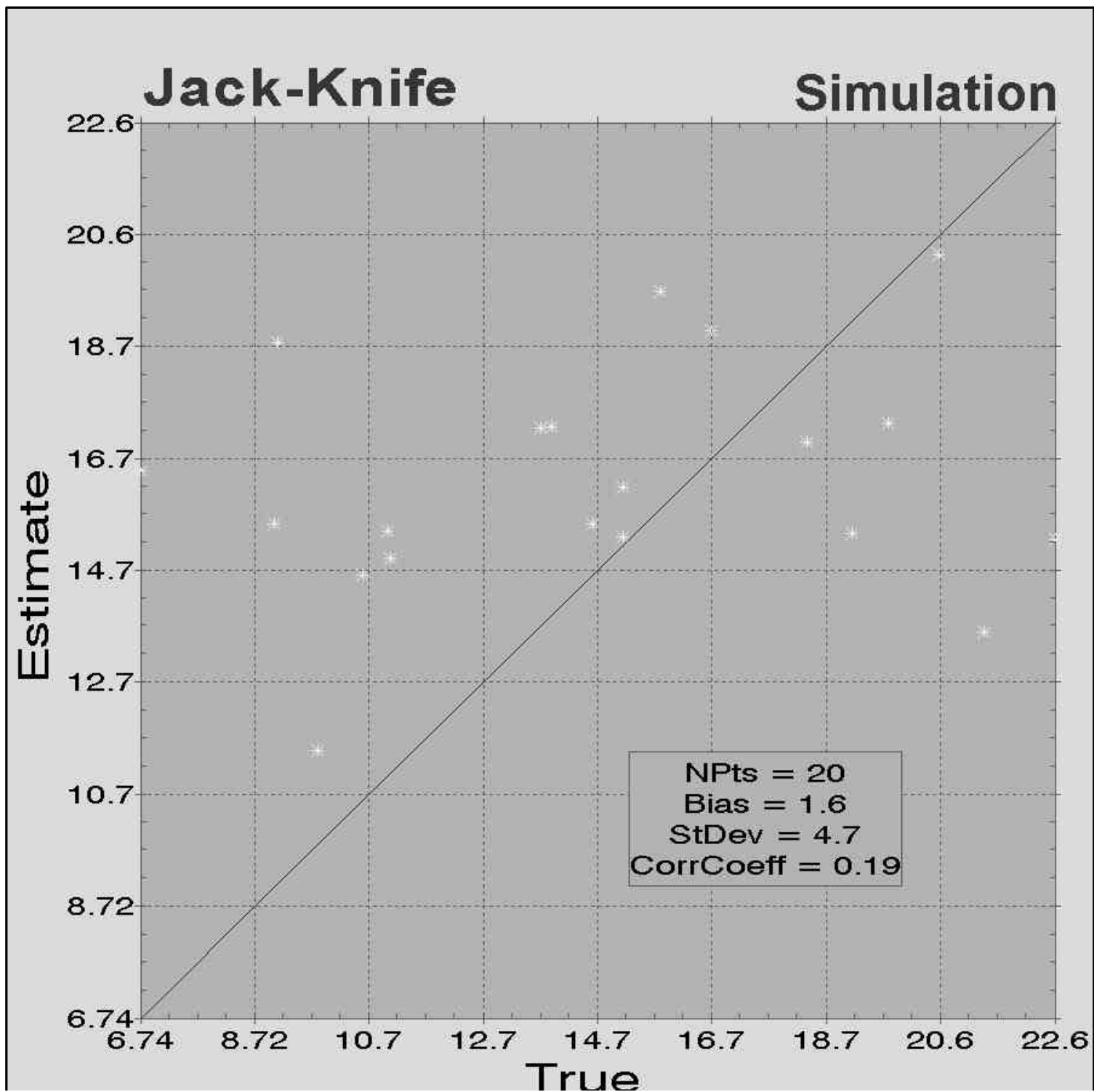
# Krige

Porosity(%)



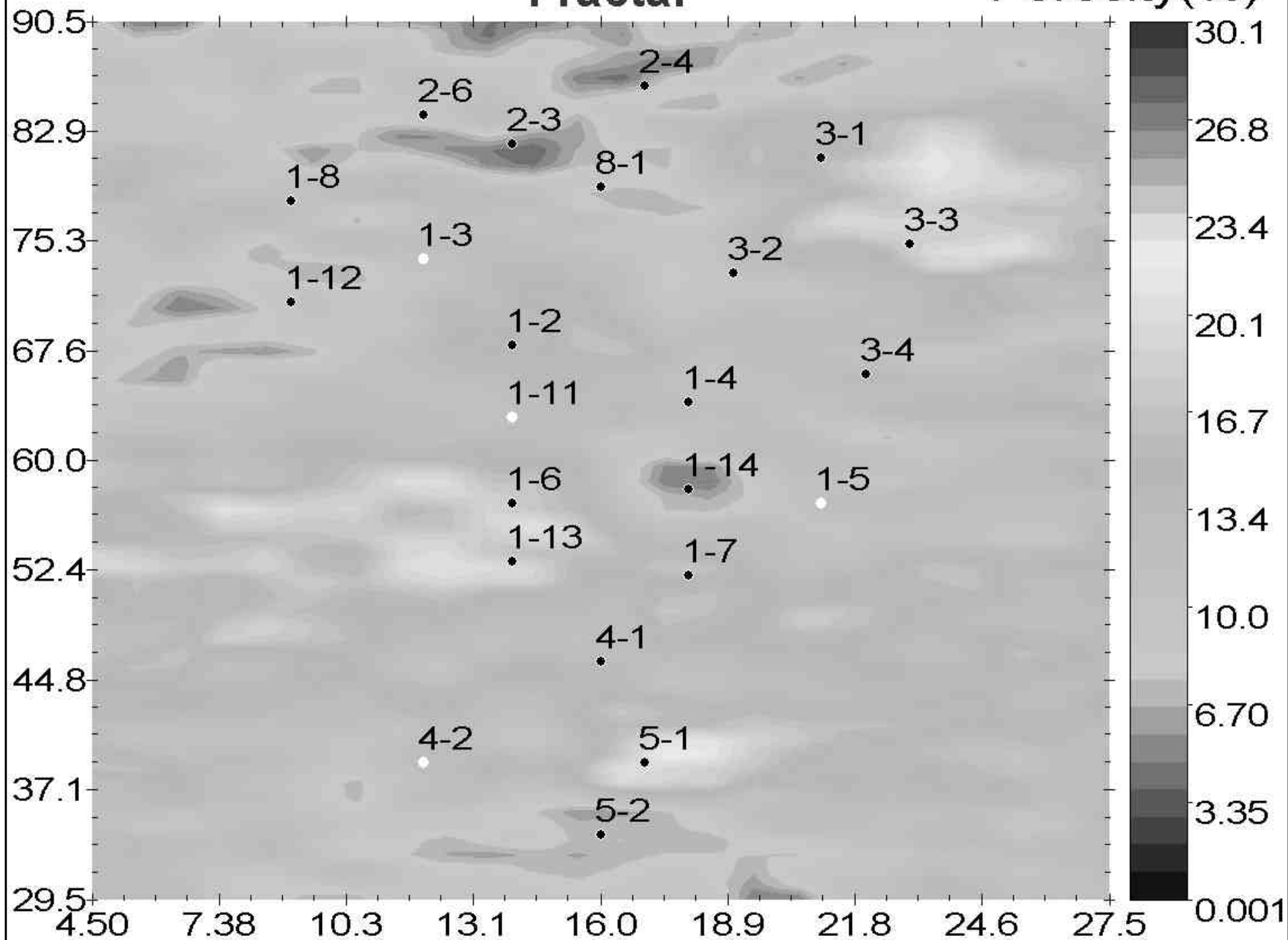




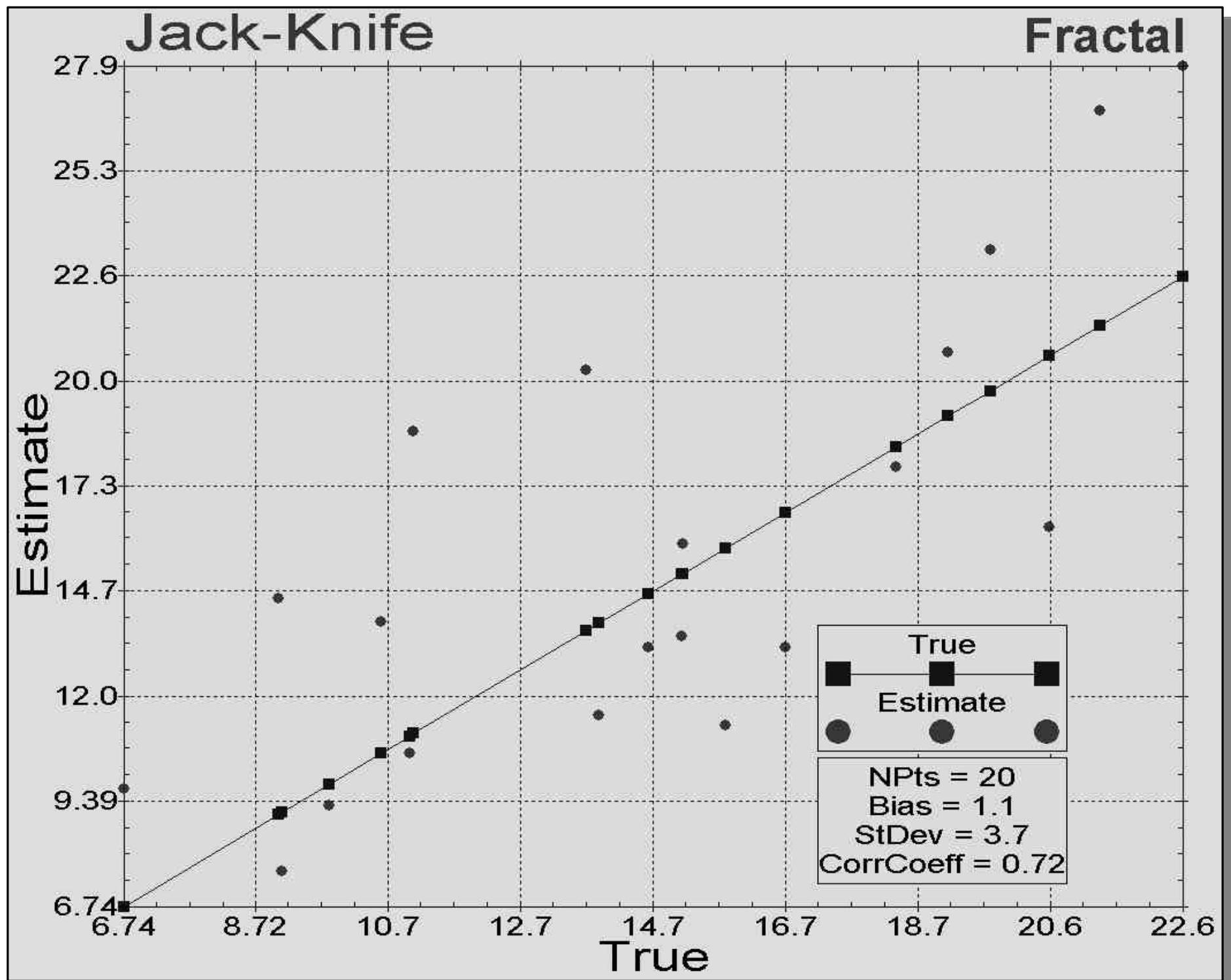


Fractal

Porosity(%)







# Variogram Features

- ❑ Both Isotropic and Anisotropic.
- ❑ A wide variety of Models:
  1. Spherical
  2. Gaussian
  3. Exponential
  4. Linear
  5. fBm: Fractional Brownian Motion
- ❑ Automatic Estimation of Model Parameters
- ❑ Interactive Estimation of Model Parameters

# Interactive Variogram

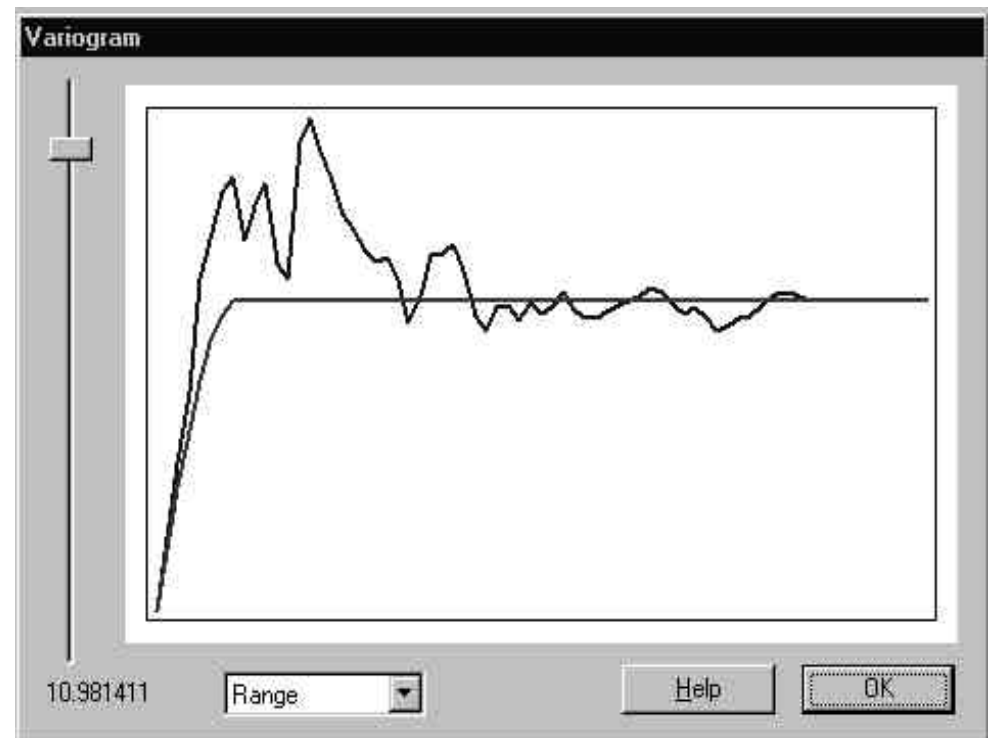
**Variogram**

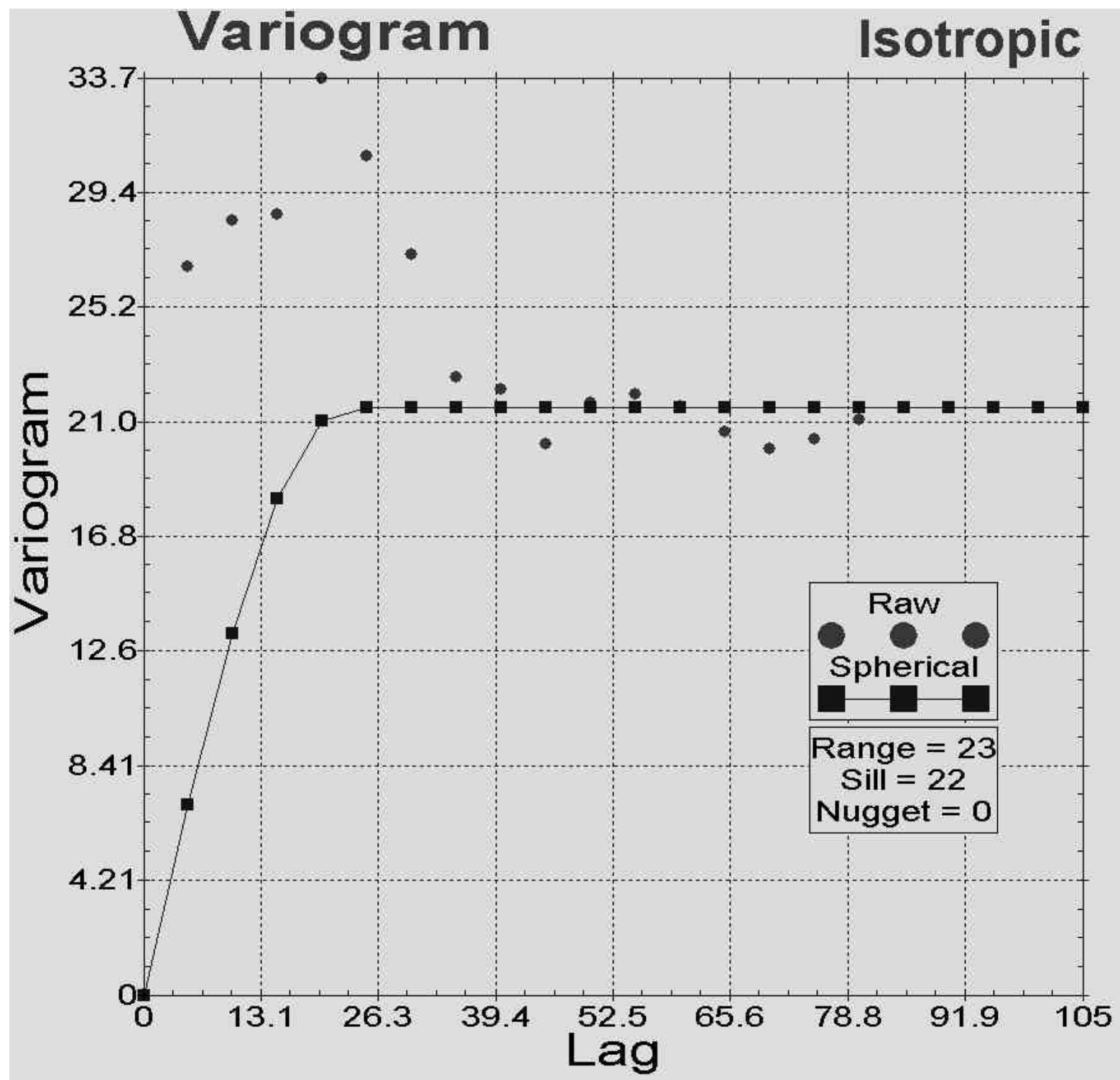
Function Choice  
☒ z1z1 ☐ z1z2 ☐ z2z2

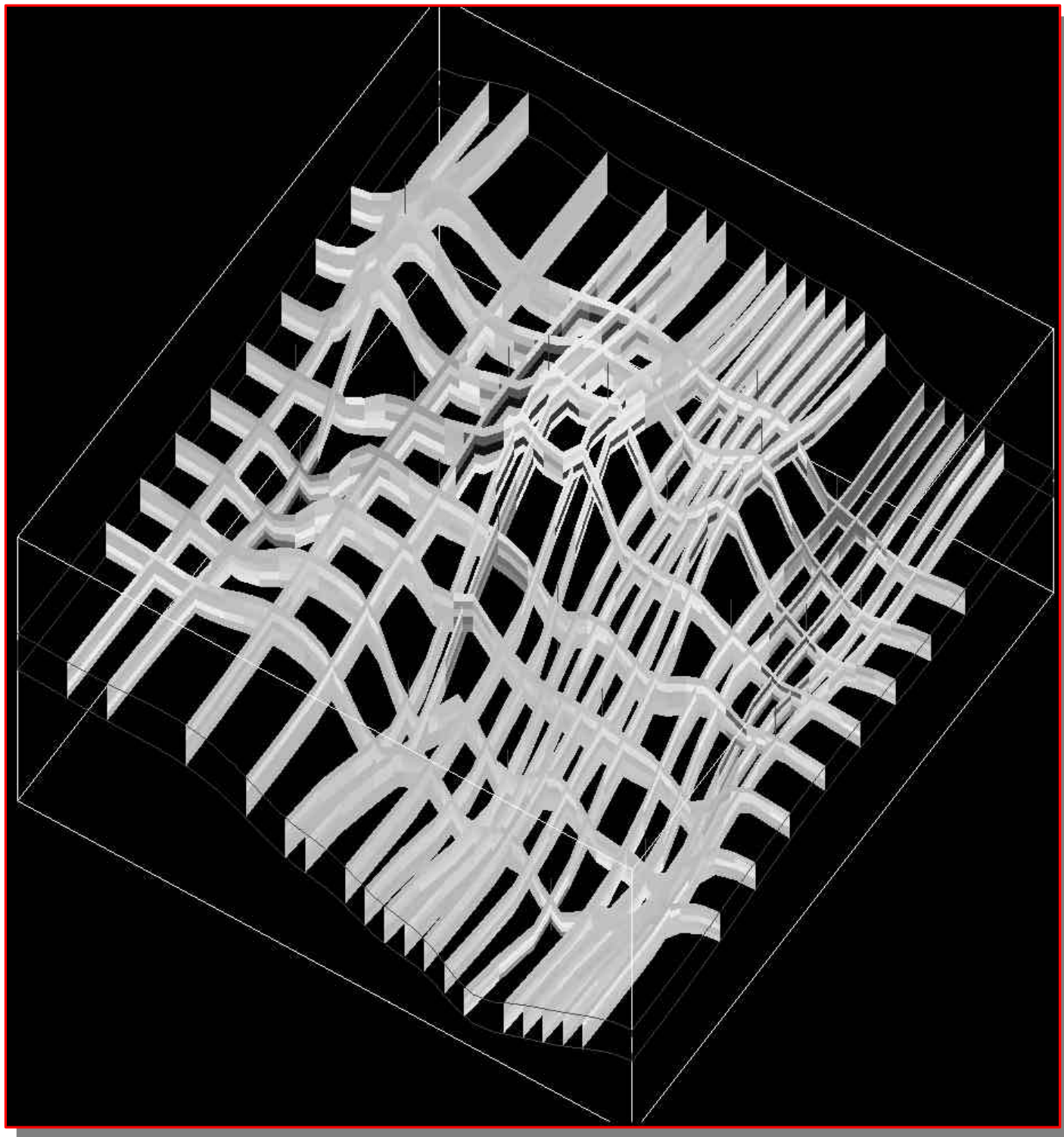
☒ Isotropic ☐ Anisotropic [Adjust Models](#)

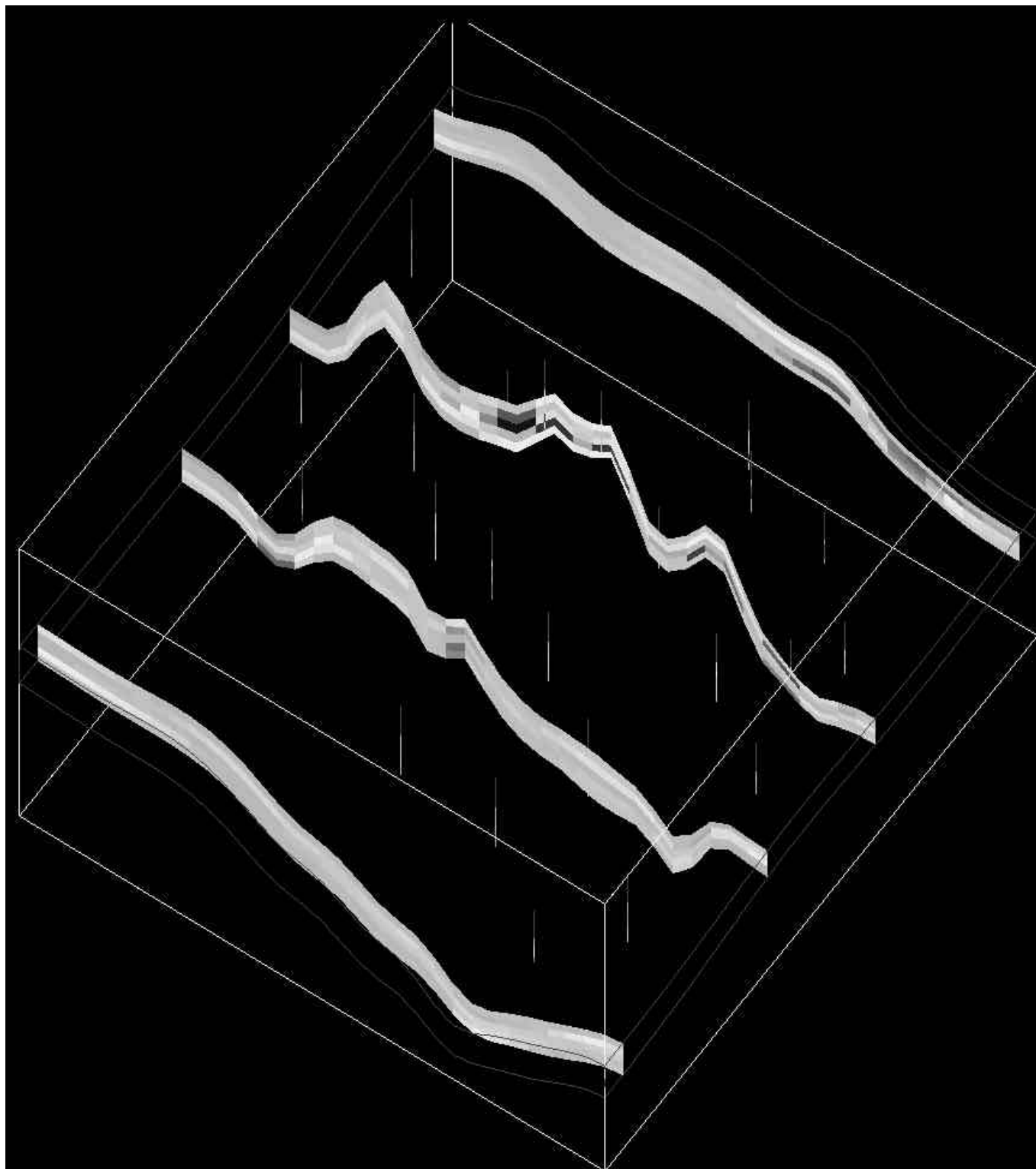
Range	4	<input type="checkbox"/>	Angle X	0
Sill	21.3660624357	<input checked="" type="checkbox"/>	Angle Y	0
Nugget	0	<input checked="" type="checkbox"/>	Angle Z	0
Scale Y	1	<input checked="" type="checkbox"/>	Angle Tolerance	10
Scale Z	1	<input checked="" type="checkbox"/>	Step Size	1.5
Co-Dimension	0.5	<input checked="" type="checkbox"/>	Model	Spherical

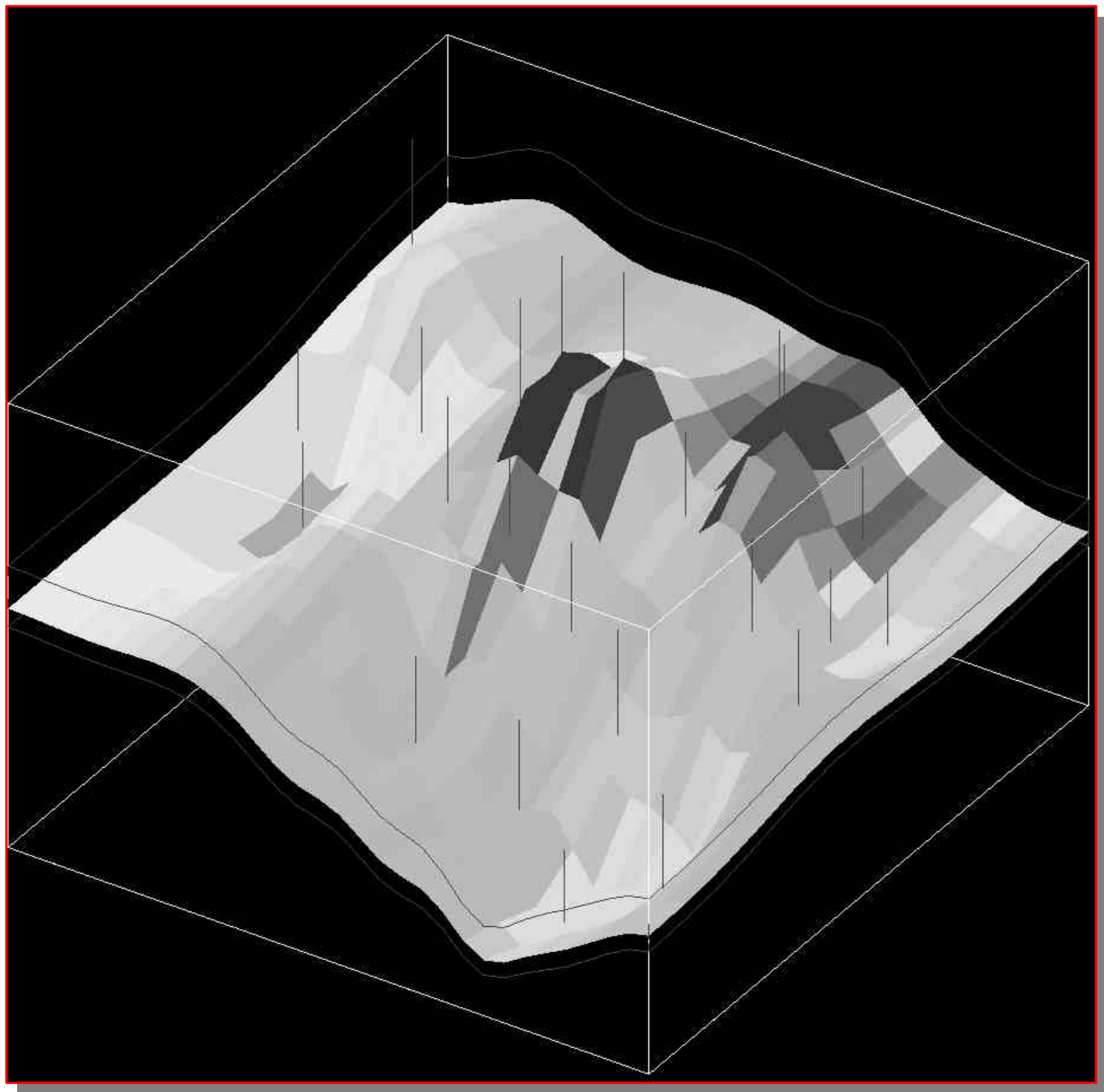
[< Back](#) [Finish](#) [Cancel](#) [Help](#)

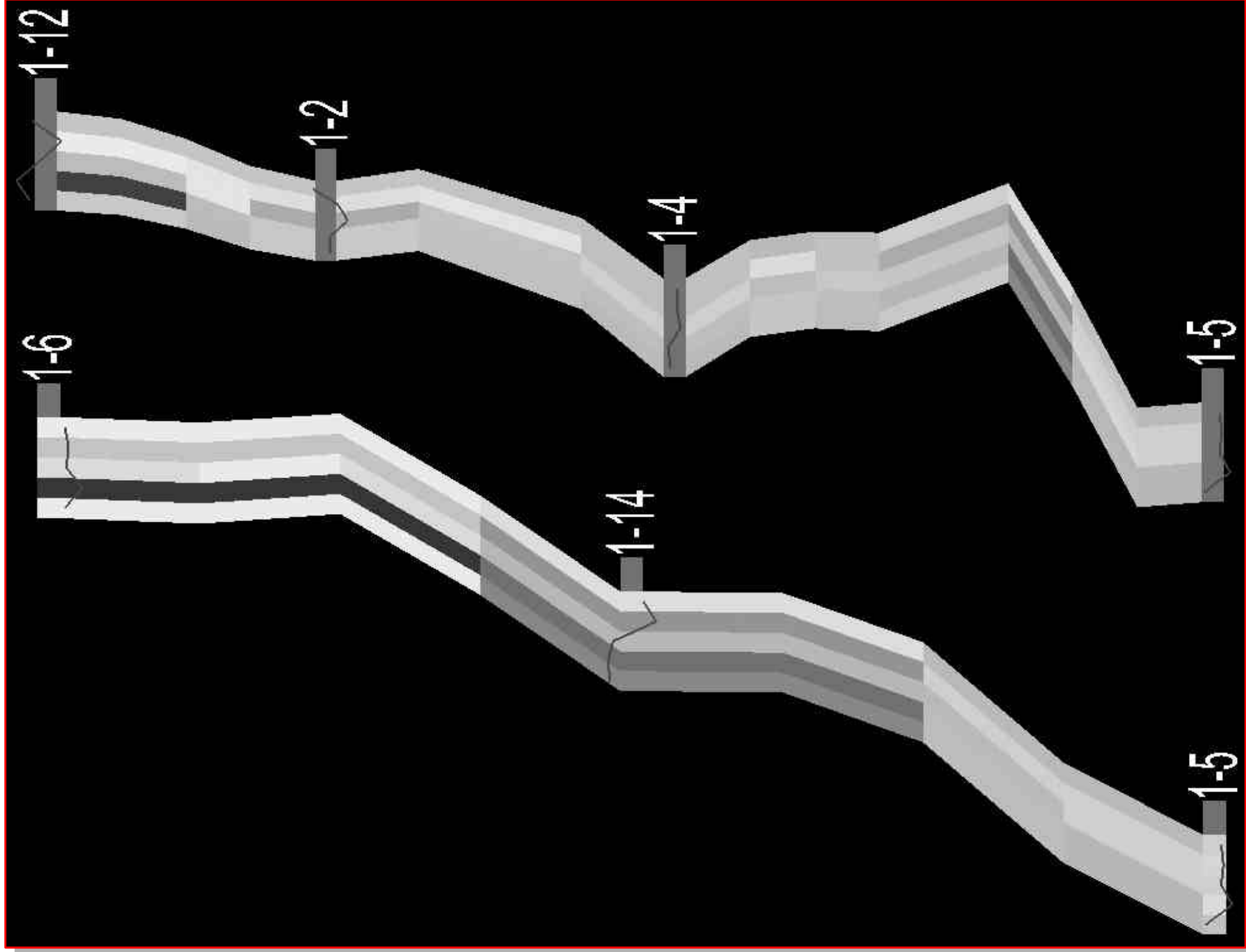




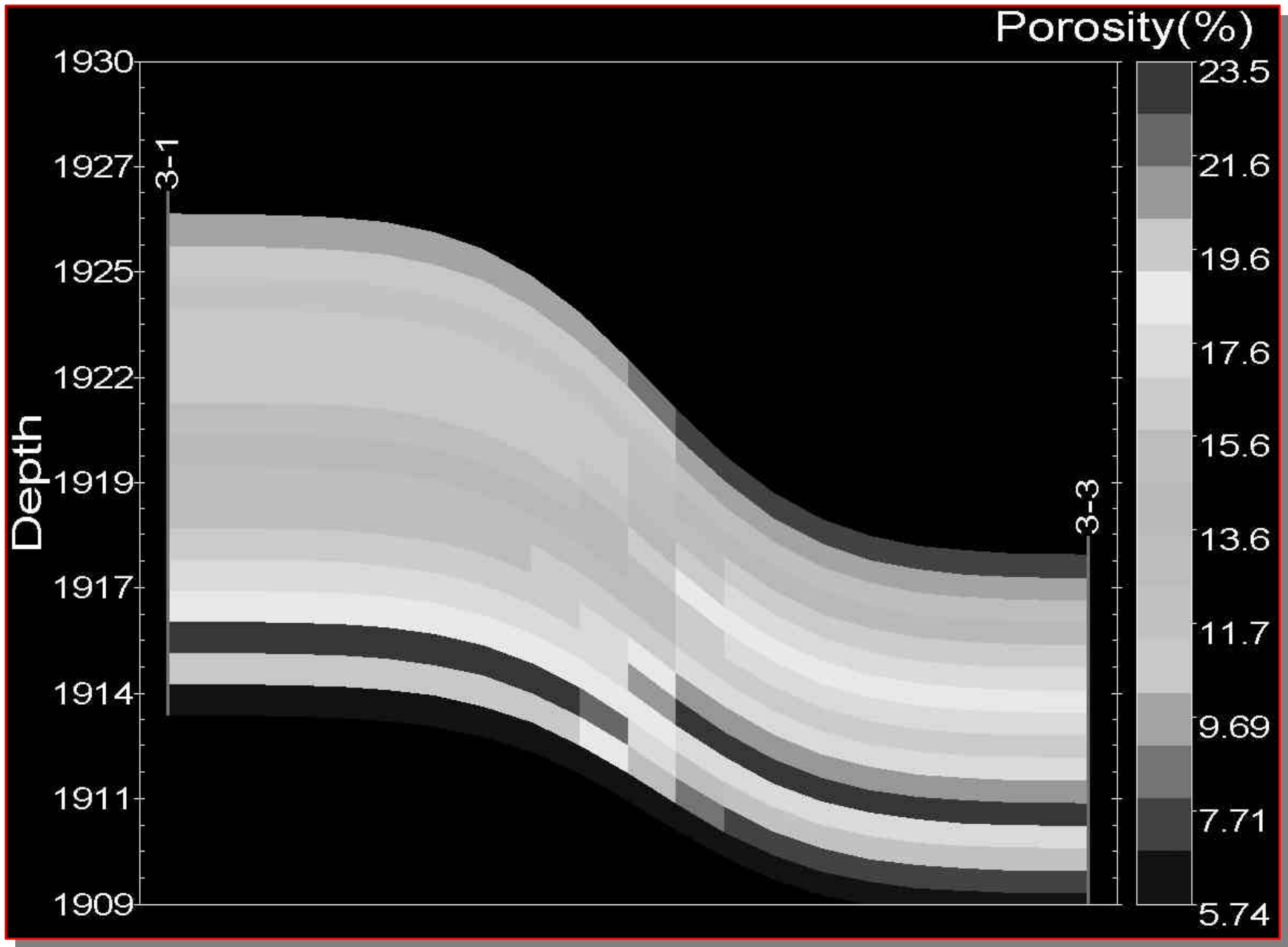


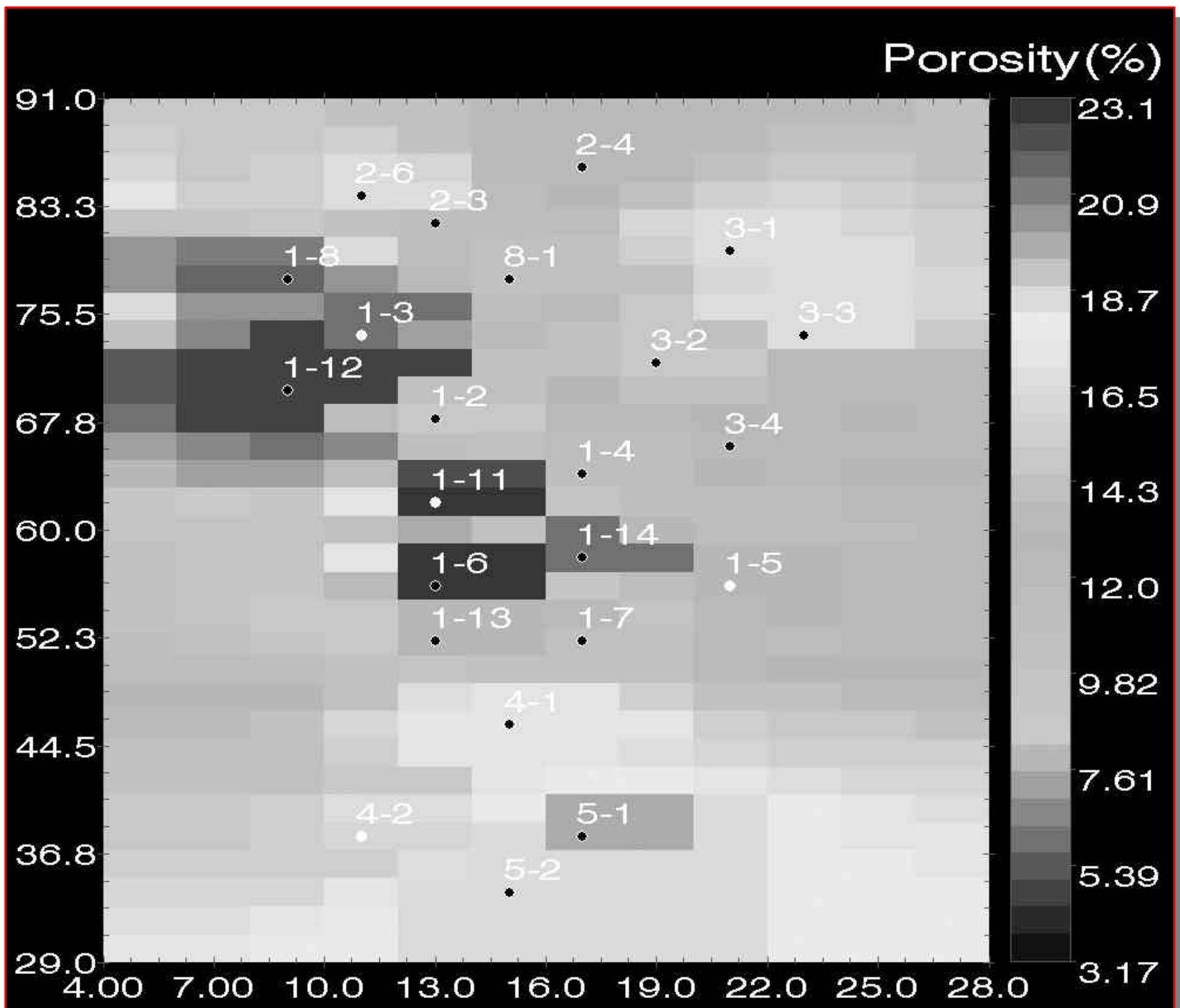




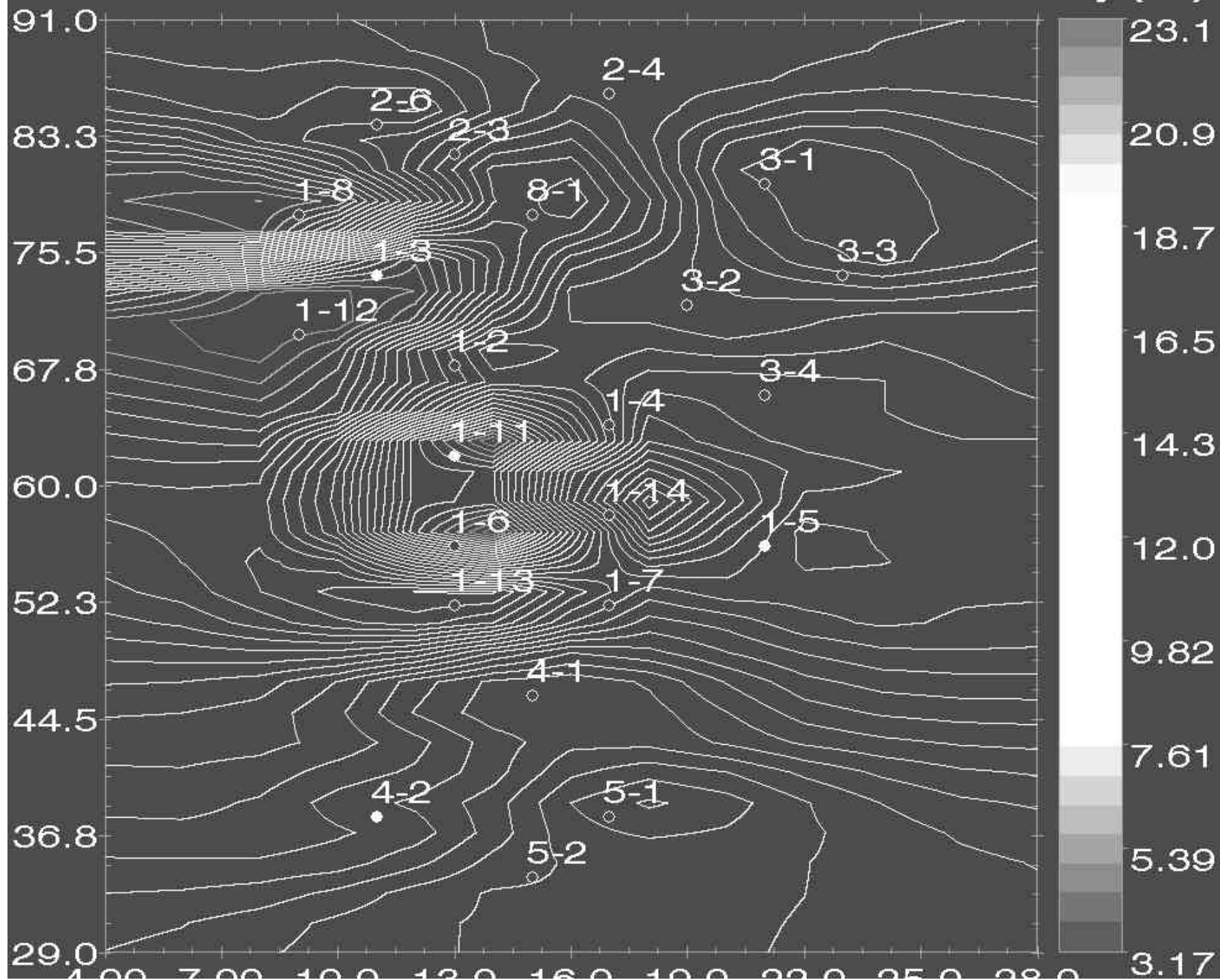




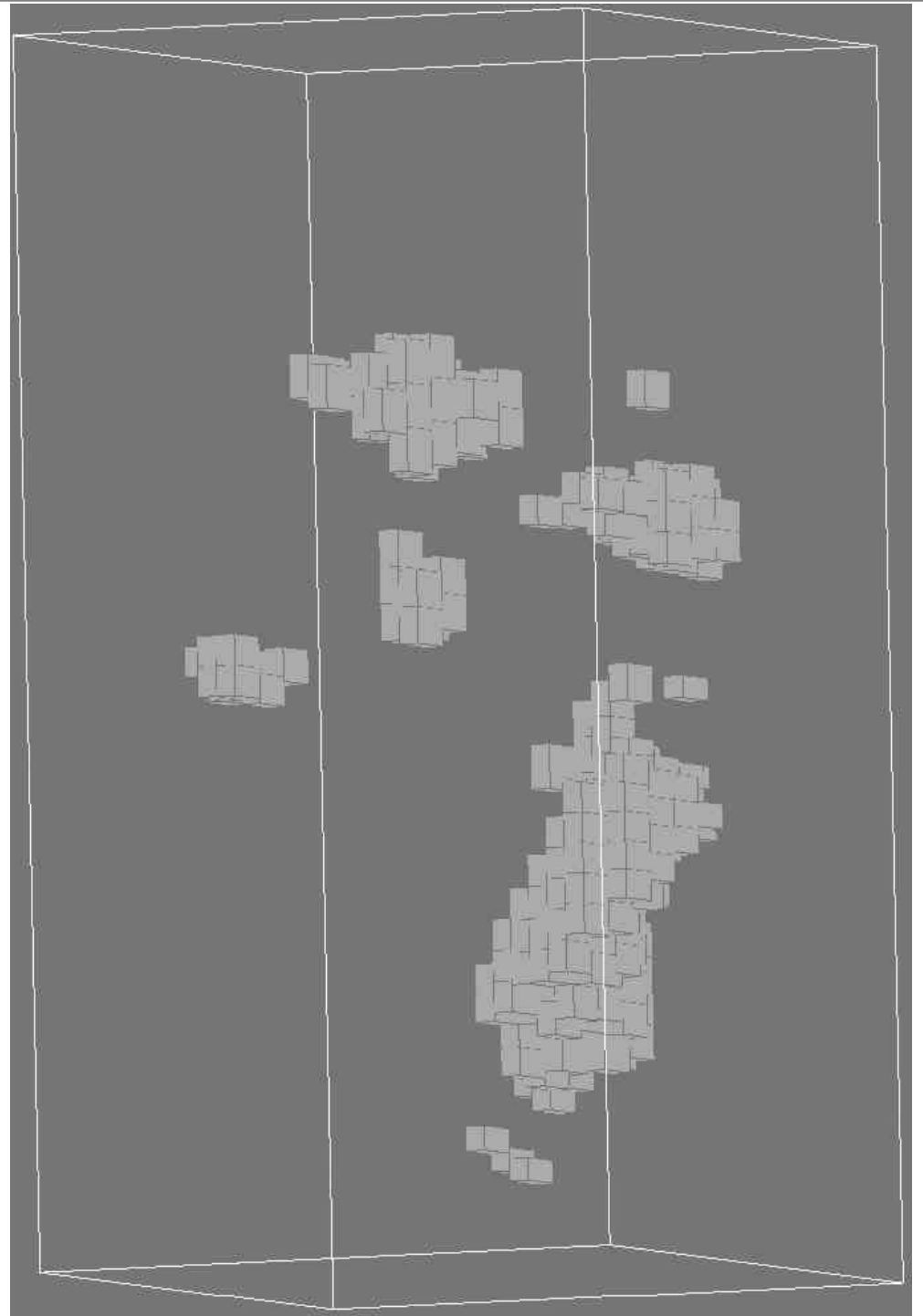




# Porosity(%)



- ✓ Reservoir Continuity (10% Cutoff)
- ✓ Sand Bodies Where Porosity is Higher than 10%
- ✓ Boolean Map



# Exporting

- ❑ Areal/Vertical Upscaling
- ❑ Export Models to Reservoir Simulations
  1. ECLIPSE
  2. VIP
  3. CMG
  4. SABRE
  5. ASCII FILES: Row, Column & XYZ.
- ❑ Export Map & Plot to JPEG & BMP format.
- ❑ Export Map & Plot to Microsoft Word and Microsoft PowerPoint for presentation.

# GViz 1.0

3D Reservoir Modeling on PCs

- ✓ 3D Reservoir Models
- ✓ 2D XY Plane Problems
- ✓ 2D Cross Section Problems
- ✓ 1D Problems